Notice No.7

Rules and Regulations for the Classification of Ships, July 2018

The status of this Rule set is amended as shown and is now to be read in conjunction with this and prior Notices. Any corrigenda included in the Notice are effective immediately.

Please note that corrigenda amends to paragraphs, Tables and Figures are not shown in their entirety.

Issue date: June 2019

Amendments to	Effective date	IACS/IMO implementation (if applicable)
Part 3, Chapter 1, Sections 6 & 9	1 July 2019	1 July 2019
Part 3, Chapter 2, Section 2	1 July 2019	1 July 2019
Part 3, Chapter 3, Section 3	1 July 2019	N/A
Part 3, Chapter 4, Section 8, sub-Section 8.2	1 July 2019	1 July 2019
Part 3, Chapter 4, Section 8	1 July 2019	N/A
Part 3, Chapter 6, Section 7	1 July 2019	1 July 2019
Part 3, Chapter 8, Section 2	1 July 2019	N/A
Part 3, Chapter 9, Section 9	1 July 2019	N/A
Part 3, Chapter 13, Section 2	1 July 2019	1 July 2019
Part 3, Chapter 14, Sections 1, 5, 7 & 9	1 July 2019	N/A
Part 4, Chapter 1, Section 8	1 July 2019	1 July 2019
Part 4, Chapter 2, Section 1	1 July 2019	N/A
Part 4, Chapter 4, Section 1	1 July 2019	N/A
Part 4, Chapter 8, Section 2	1 July 2019	N/A

Lloyd's Register

Part 3, Chapter 1
General

■ *Section 6*
Definitions

6.3 Bulkhead deck

6.3.1 For a passenger ship the bulkhead deck is generally to be taken as the deck to which the main bulkheads and side shell are carried watertight.

6.3.2 For a cargo ship the bulkhead deck is generally to be taken as the freeboard deck.

Existing sub-Sections 6.3 to 6.8 have been renumbered as 6.4 to 6.9.

■ *Section 9*
Procedures for testing tanks and tight boundaries

9.2 Application

(Part only shown)

Table 1.9.1 Testing requirements

Item to be tested	Testing procedure	Testing requirement
Watertight doors below freeboard or bulkhead deck, and watertight hatches	Leak	*See* Notes 6 and 12
Note *3.* Including dry compartments and duct keels arranged in accordance with the provisions of SOLAS Chapter II-1 *Regulation 9 - Double bottoms in passenger ships and cargo ships other than tankers* and *Regulation 11 - Initial testing of watertight bulkheads, etc*., as well as voids used for the protection of fuel oil tanks and pump rooms arranged in accordance with the provisions of MARPOL Annex I, *Reg. 12A* and *Reg. 22*. Note *6.* Watertight doors and hatches not confirmed watertight by a prototype test are to be subject to a hydrostatic test, *see* SOLAS Chapter II-1 *Regulation 16 - Construction and initial tests of watertight* closures ~~doors, sidescuttles, etc~~*.* Note *10.* Other testing methods listed in *Pt 3, Ch 1, 9.7 Definitions and details of tests 9.7.7* and *Pt 3, Ch 1, 9.7 Definitions and details of tests 9.7.8* may be considered, subject to adequacy of such testing methods being verified, *see* SOLAS Chapter II-1 *Regulation 11 - Initial testing of watertight bulkheads, etc.* Note 12. All watertight doors and hatches are to be hose tested after installation. Hose testing is to be carried out from each side of a door or hatch unless, for a specific application, flooding is anticipated from only one side. Where a hose test is not practicable because of possible damage to machinery, electrical equipment insulation or outfitting items, it may be replaced by an ultrasonic leak test or an equivalent test.		

Part 3, Chapter 2
Materials

■ *Section 2*
Fracture control

2.1 Grades of steel

(Part only shown)

2.1.4 Design for normal worldwide service assumes the navigation to areas of minus 10°C, where the design air temperature is to be taken as the lowest mean daily average air temperature in the area of operation:

where
Mean = statistical mean over a minimum of 20 years
Average = average during one day and one night
Lowest = lowest during the year
MDHT = Mean Daily High Temperature
MDAT = Mean Daily Average Temperature
MDLT = Mean Daily Low Temperature

Figure 2.2.1 Design air temperature shows the definition graphically.

The material grade of exposed structure of ships intended to operate in external air temperatures below minus 10°C is to be in accordance with *Pt 3, Ch 2, 2.3 Structures exposed to low temperatures*. ~~will be specially considered, *see also Rules for the Winterisation of Ships, July 2018*.~~

2.3 Structures exposed to low temperatures

2.3.1 For ships intended to operate in areas with low air temperatures (below −10°C), e.g. regular service during winter seasons to Arctic or Antarctic waters, the material grade requirements of structures above the lowest ballast water line exposed to air are not to be of lower grades than those given in *Table 2.2.5 Material classes and grades for structures exposed to low air temperatures, Table 2.2.6 Materials for Class I for low air temperatures, Table 2.2.7 Materials for Class II for low air temperatures* and *Table 2.2.8 Materials for Class III for low air temperatures.*

2.3.2 Where the material class in *Table 2.2.1 Material classes and grades* is higher than in *Table 2.2.5 Material classes and grades for structures exposed to low air temperatures*, the higher material class is to be applied.

2.3.3 For ships where the optional **Winterisation H** notation is applied, *see Rules for the Winterisation of Ships, July 2019*, note that the external design air temperature defined in the Winterisation Rules is taken as 13°C lower than the design air temperature, i.e. if the design air temperature is −11°C, then the external design air temperature for the application of the Winterisation Rules is −24°C.

2.4 Carriage of cold cargoes

2.4.1 For ships other than liquefied gas carriers, which are intended to be loaded with liquid cargo having a temperature below −10°C, e.g. loading from cold onshore storage tanks during winter conditions, the grade of steel for the cargo tank boundary plating is to comply with the requirements *Table 2.2.6 Materials for Class I for low air temperatures* where the design air temperature is to be taken as the design minimum cargo temperature in °C. The design minimum cargo temperature is to be specified in the Loading Manual, *see Pt 3, Ch 4, 8.2 Loading Manual 8.2.4.*

Table 2.2.5 Material classes and grades for structures exposed to low air temperatures

Structural member category	Material class	
	Within 0,4*L* amidships	Outside 0,4*L* amidships
SECONDARY	I	I
• Deck plating exposed to weather, in general • Side plating above CWL, *see* Note 5 • Transverse bulkheads above CWL, *see* Notes 5 and 6		
PRIMARY	II	I
• Strength deck plating • Continuous longitudinal members above strength deck, excluding longitudinal hatch coamings • Longitudinal bulkhead above CWL, *see* Notes 5 and 6 • Top wing tank bulkhead above CWL, *see* Notes 5 and 6		
SPECIAL	III	II
• Sheerstrake at strength deck, *see* Note 1 • Stringer plate in strength deck, *see* Note 1 • Deck strake at longitudinal bulkhead, *see* Note 2 • Continuous longitudinal hatch coamings, *see* Note 3		

Note *1*. Not to be less than Grade E/EH within 0,4*L* amidships in ships with length exceeding 250 m.

Note *2*. In ships with breadth exceeding 70 m at least three deck strakes are to be Class III.

Note *3*. Not to be less than Grade D/DH.

Note *4*. Within 0,4*L* amidships, single strakes which are required to be of Class III or of Grade E/EH or FH are to have breadths not less than 800 + 5*L*, but need not be taken greater than 1800 mm.

Note *5*. The Cold Waterline (CWL) is to be taken as 0,3 m below the minimum design Ballast Waterline (BWL).

Note *6*. Applicable to plating attached to hull envelope plating exposed to cold air. At least one strake is to be considered in the same way as exposed plating and the strake width is to be at least 600 mm. If thermal stress calculations are performed, then the extent of plate requiring consideration is to be adjusted accordingly.

Table 2.2.6 Materials for Class I for low air temperatures

Thickness, mm	Design air temperature									
	−11°C to −15°C		−16°C to −25°C		−26°C to −35°C		−36°C to −45°C		−46°C to −55°C	
	MS	HT	MS	HT	MS	HT	MS	HT	MS	HT
$t \le 10$	A	AH	A	AH	B	AH	D	DH	D	DH
$10 < t \le 15$	A	AH	B	AH	D	DH	D	DH	D	DH
$15 < t \le 20$	A	AH	B	AH	D	DH	D	DH	E	EH
$20 < t \le 25$	B	AH	D	DH	D	DH	D	DH	E	EH
$25 < t \le 30$	B	AH	D	DH	D	DH	E	EH	E	EH
$30 < t \le 35$	D	DH	D	DH	D	DH	E	EH	E	EH
$35 < t \le 45$	D	DH	D	DH	E	EH	E	EH	n/a	FH
$45 < t \le 50$	D	DH	E	EH	E	EH	n/a	FH	n/a	FH
Note. MS and HT are defined as Mild Steel and High Tensile Steel respectively.										

Table 2.2.7 Materials for Class II for low air temperatures

Thickness, mm	Design air temperature									
	−11°C to −15°C		−16°C to −25°C		−26°C to −35°C		−36°C to −45°C		−46°C to −55°C	
	MS	HT	MS	HT	MS	HT	MS	HT	MS	HT
$t \le 10$	A	AH	B	AH	D	DH	D	DH	E	EH
$10 < t \le 20$	B	AH	D	DH	D	DH	E	EH	E	EH
$20 < t \le 30$	D	DH	D	DH	E	EH	E	EH	n/a	FH
$30 < t \le 40$	D	DH	E	EH	E	EH	n/a	FH	n/a	FH
$40 < t \le 45$	E	EH	E	EH	n/a	FH	n/a	FH	n/a	n/a
$45 < t \le 50$	E	EH	E	EH	n/a	FH	n/a	FH	n/a	n/a
Note. MS and HT are defined as Mild Steel and High Tensile Steel respectively.										

Table 2.2.8 Materials for Class III for low air temperatures

Thickness, mm	Design air temperature									
	−11°C to −15°C		−16°C to −25°C		−26°C to −35°C		−36°C to −45°C		−46°C to −55°C	
	MS	HT	MS	HT	MS	HT	MS	HT	MS	HT
$t \le 10$	B	AH	D	DH	D	DH	E	EH	E	EH
$10 < t \le 20$	D	DH	D	DH	E	EH	E	EH	n/a	FH
$20 < t \le 25$	D	DH	E	EH	E	EH	E	FH	n/a	FH
$25 < t \le 30$	D	DH	E	EH	E	EH	E	FH	n/a	FH
$30 < t \le 35$	E	EH	E	EH	n/a	FH	n/a	FH	n/a	n/a
$35 < t \le 40$	E	EH	E	EH	n/a	FH	n/a	FH	n/a	n/a
$40 < t \le 50$	E	EH	n/a	FH	n/a	FH	n/a	n/a	n/a	n/a
Note. MS and HT are defined as Mild Steel and High Tensile Steel respectively.										

■ *Section 3*
Structural idealisation

3.4 Calculation of hull section modulus

3.4.1 All continuous longitudinal structural material is to be included in the calculation of the inertia of the hull midship section, and the lever *z* is, except where otherwise specified for particular ship types, to be measured vertically from the neutral axis to the top of keel and to the moulded strength deck line at the side. The strength deck is to be taken as follows:

(a) Where there is a complete upper deck and no effective superstructure, the strength deck is the upper deck.

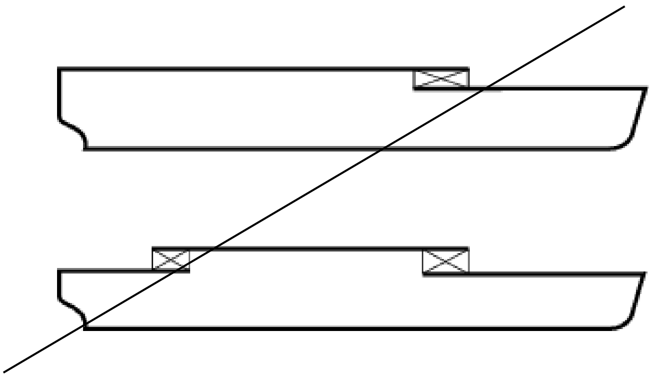
(b) Where the upper deck is stepped, as in the case of a raised quarterdeck ~~ships~~ or a long forecastle, or there is an effective superstructure on the upper deck, the strength deck is stepped ~~as shown in *Figure 3.3.4 Strength deck stepping*~~.

3.4.2 ~~An effective superstructure is one which exceeds 0,15L in length~~ ~~and extends inside the midship 0,5L region~~. ~~Superstructure decks less than 12 m in length are not to be considered as strength deck.~~ A transition zone, *see Figure 3.3.4 Midship strength deck stepping* and *Figure 3.3.5 Local strength deck stepping*, is to be assumed at the ends of effective superstructures and at the end of stepped decks, where the longitudinal material cannot be included in the calculation of the hull section modulus. The length of the zone is to be taken as four times the deck height. Local insert plates are to be fitted in the side shell as appropriate with a thickness at least 25 per cent greater than the adjacent plating. They are to extend a minimum of one primary frame spacing forward and aft, but are to be not less than 1500 mm each way from the end of the transition zone. For vessels with complex arrangements or geometries, shadow plan areas are to be submitted.

3.4.3 A superstructure deck or stepped deck can only be considered as the strength deck and included in the calculation of hull midship section modulus if it extends at least the complete 0,4*L* amidships and transversely to the side shell with transition zones being located aft and forward (as appropriate) outside of this length.

3.4.4 A superstructure deck or stepped deck can only be considered effective and used in local section modulus calculations if it extends at least 0,15*L* and transversely to the side shell with the transition zones being located aft and forward outside of this length.

Existing paragraphs 3.4.3 to 3.4.15 have been renumbered as 3.4.5 to 3.4.17.



~~**Figure 3.3.4 Strength deck stepping**~~

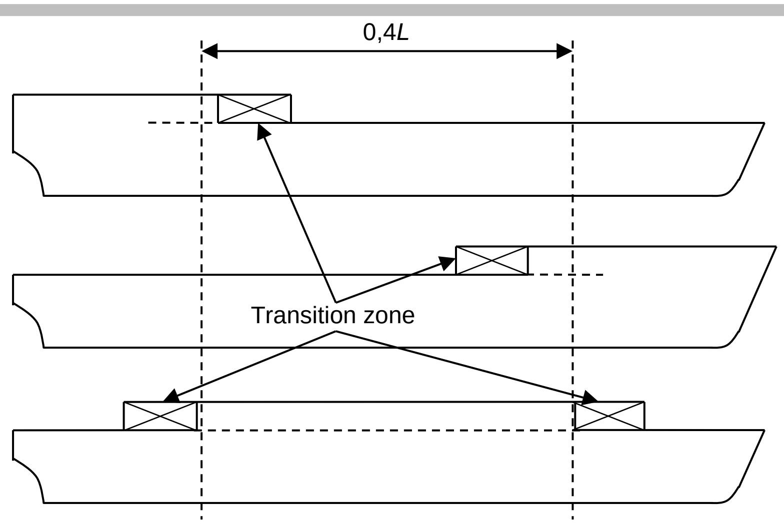


Figure 3.3.4 Midship strength deck stepping

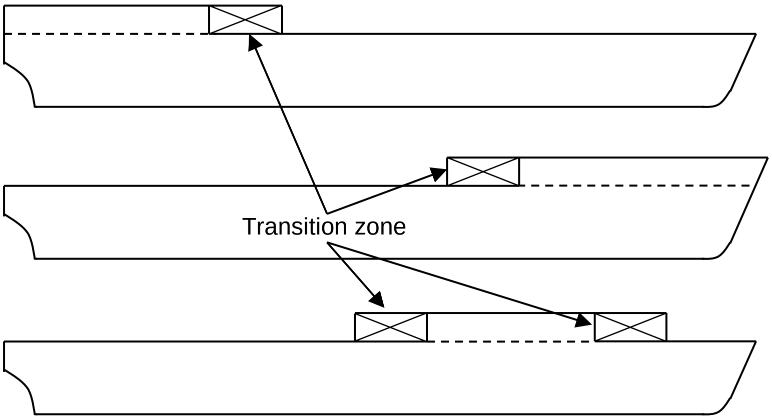


Figure 3.3.5 Local strength deck stepping

Existing Figure 3.3.5 has been renumbered Figure 3.3.6.

Part 3, Chapter 4
Longitudinal Strength

■ *Section 8*
Loading guidance information

8.2 Loading Manual

(Part only shown)

8.2.4 The Manual is also to contain the following:

(d) A note saying:
'Scantlings approved for minimum draught forward of ...m with ballast tanks No... filled. In heavy weather conditions the forward draught should not be less than this value. If, in the opinion of the Master, sea conditions are likely to cause regular slamming, then other appropriate measures such as change in speed, heading or an increase in draught forward may also need to be taken.'

(f) The design minimum cargo temperature in °C for ships other than liquefied gas carriers which are intended to be loaded with liquid cargo having a temperature below −10°C, *see Pt 3, Ch 2, 2.4 Carriage of cold cargoes 2.4.1*.

8.4 Onboard lashing program

8.4.1 An onboard lashing program to calculate forces acting on the container stowage arrangement may be provided, *see Pt 3, Ch 14 Cargo Securing Arrangements*. This may be an extension to the loading instrument covered under *Pt 3, Ch 4, 8.3 Loading instrument*. If the software to carry out lashing calculations is installed and maintained in accordance with the Rules, the ship will be eligible to be assigned the special features notation **BoxMax**, with one or more of the supplementary letters **V** and **W**. The notation **BoxMax(V,W)** may be supplemented with the letter **L** if the conditions for this notation are satisfied. **BoxMax** may be supplemented with the letter **M** if the conditions for this notation are satisfied.

8.4.2 For description of the **BoxMax** notation and its **V, W,** ~~and~~ **L** and **M** features, see *Pt 3, Ch 14, 1.2 Classification notations and descriptive notes*.

8.4.4 To qualify for the aspects of the notation, i.e. **V, W,** ~~and~~ **L** and **M**, the Surveyor is to verify upon installation and at Annual and Periodical Surveys as required in *Pt 1, Ch 3 Periodical Survey Regulations* that the individual features of the notation are implemented in the onboard lashing program. The Surveyor is also to verify that an Operation Manual for these aspects of the onboard lashing program is available on board.

Part 3, Chapter 6
Aft End Structure

■ *Section 7*
Sternframes and appendages

7.5 Rudder trunks

7.5.1 Rudder trunks extending above or below the stern-frame are to be constructed of steel of a weldable quality with a carbon content not exceeding 0,23 per cent on ladle analysis ~~and~~ or a carbon equivalent (CEQ) not exceeding 0,41 per cent.

Part 3, Chapter 8
Superstructures, Deckhouses and Bulwarks

■ *Section 2*
Scantlings of erections other than forecastles

2.7 Erections contributing to hull strength

2.7.1 Where a long superstructure or deckhouse is fitted, extending at least 0,15*L* ~~within 0,5*L* amidships~~, the scantlings of the first tier deck plating and longitudinals may be required to be increased, *see also Pt 3, Ch 3, 3.4 Calculation of hull section modulus* and *Pt 3, Ch 4, 2.3 Open ship types*.

Part 3, Chapter 9
Special features

■ *Section 9*
Strengthening for machinery on deck

9.1 Application

9.1.1 Where it is intended to install machinery on deck, the requirements of this Section are to be complied with and the notation '**Machinery on deck**' will be assigned.

9.1.2 Where the concentrated loads calculated in accordance with *Pt 3, Ch 9, 9.2 Loading* are less than the specified deck design load required by *Pt 3, Ch 3, Table 3.5.1 Design heads and permissible cargo loadings* or where the ship has been assigned a '**Heavy deck loads**' notation and the machinery loading is less than the assigned heavy deck cargo loading, then the requirements of this Section need not be applied and the notation will not be assigned.

9.1.3 The requirements of this Section do not apply to lifting appliances, anchoring and mooring equipment, or towing equipment.

9.2 Loading

9.2.1 The motions of the ship and the wind loading are to be considered in deriving the loads acting on the ship.

9.2.2 The design accelerations are to be calculated in accordance with *Pt 3, Ch 9, 9.2 Loading 9.2.3* and applied as considered necessary. Other means of deriving the design accelerations such as direct calculation or model testing will be specially considered.

9.2.3 The following formulae are given as guidance for the components of acceleration due to ship motions and apply to ships with a length exceeding 50 metres and where the speed is such that the ship is operating within the displacement mode based on normal ship service speed.

Vertical acceleration due to heave, pitch and roll motions:

$a_z = \pm\sqrt{a_{\text{heave}}^2 + a_{\text{pitch}}^2 + a_{\text{rollz}}^2}$

Transverse acceleration due to sway, yaw and roll motions:

$a_y = \pm\sqrt{a_{\text{sway}}^2 + a_{\text{yaw}}^2 + a_{rolly}^2}$

Longitudinal acceleration due to surge motions:

$a_x = \pm a_0\sqrt{0{,}06 + A^2 - 0{,}25A}$

Where:

$A = f_{\text{HS}} f_{\text{st}}(0{,}7 - \frac{L}{1200} + \frac{5(z-T)}{L})\left(\frac{0{,}6}{C_b}\right)$

a_x, a_y and a_z are the maximum dimensionless accelerations (i.e. relative to the acceleration of gravity) in their respective directions and are considered as acting separately for calculation purposes.

a_x is measured positive in the forward direction. Includes the component due to static weight in the longitudinal direction due to pitching.

a_y is measured positive in the transverse direction to port. Includes the component due to static weight in the transverse direction due to rolling.

a_z is measured positive in the downwards direction, i.e. adds to g. Does not include the component due to static weight.

$a_0, a_{\text{heave}}, a_{\text{pitch}}, a_{\text{sway}}, a_{\text{yaw}}, a_{\text{rolly}}, a_{\text{rollz}}, f_{\text{st}}$ and A are defined in *Table 9.9.1 Ship motions.*

f_{HS} is taken as 1 for unrestricted sea going service.

T, L and C_b are defined in *Pt 3, Ch 1, 6.1 Principal particulars.*

z is the vertical distance, in metres, from the keel line to the position or centre of gravity of the item being considered.

Table 9.9.1 Ship motions

Motion		Acceleration
Heave		$a_{\text{heave}} = a_0$
Pitch		$a_{\text{pitch}} = a_0\left(5{,}3 - \frac{45}{L}\right)\left(\frac{x - LCG}{L}\right)\left(\frac{0{,}6}{C_b}\right)^{0.75}$
Sway		$a_{\text{sway}} = 0{,}78a_0$
Yaw		$a_{\text{yaw}} = a_0 1{,}6\left(\frac{x - LCG}{L}\right)$
Roll	Acceleration due to Roll Vertical direction	$a_{\text{rollz}} = a_0\frac{0{,}6yK^{1{,}5}}{B}$
Roll	Acceleration due to Roll Transverse direction	$a_{\text{rolly}} = a_0\sqrt{K}\left(1 + 0{,}6K\left(\frac{z - T}{B}\right)\right)$
		$a_0 = f_{\text{HS}} f_{\text{st}}\left(\frac{0{,}2V_a}{\sqrt{L}} + \frac{34 - \left(\frac{600}{L}\right)}{L}\right)$
Relative vertical motion		$H_{\text{rm}} = C_{\text{w,min}}\left(1 + \frac{k_r}{(C_b + 0{,}2)}\left(\frac{x}{L} - x_m\right)^2\right)$
Symbols		
f_{st}		$V_a = \frac{2}{3}V$

	= correction factor for long term (10^{-8}) acceleration value to average of the highest 1/100 acceleration values = 0,8		*V* is maximum service speed in knots
		F_n	$= \frac{0{,}515 V_a}{\sqrt{gL}}$
C_w	= a wave head, in metres	*K*	$= 13 \frac{B}{GM}$ but is not to be taken less than 1
	$= 7.71 \times 10^{-2} L e^{-0.0044L}$ but is not to be taken greater than 227	*GM*	Is the metacentric height in metres
$C_{w,min}$	$= \frac{C_w}{k_m} \sqrt{\frac{2{,}25}{k_r}}$	f_{HS}	is defined in *Pt 3, Ch 9, 9.2 Loading 9.2.3*
k_m	$= 1 + \frac{k_r (0{,}5 - x_m)}{(C_b + 0{,}2)}$	*L, T, B* and C_b	are defined in *Pt 3, Ch 1, 6.1 Principal particulars*
x_m	$= 0{,}45 - 0{,}6 F_n$ but x_m is not to be taken less than 0,2	*x*	is the longitudinal position of the location under consideration measured from the aft end of *L*
k_r	=2,25	*LCG*	is the longitudinal centre of gravity of the ship measured in metres from the aft end of *L*

Note

Heave motion is measured positive upwards.

Pitch motion is measured positive bow downwards.

Sway motion is measured positive to port.

Yaw motion is measured positive bow to port.

Roll motion is measured positive port side upwards.

9.2.4 The wind force is to be calculated in accordance with the requirements of *Pt 3, Ch 9, 9.2 Loading 9.2.4* and *Pt 3, Ch 9, 9.2, 9.2.5.* The wind force acting in the most onerous direction for the case being considered is to be applied.

9.2.5 The wind pressure, *p*, acting on the structure is given by:

$$p = \frac{V^2}{1630} \quad \text{kN/m}^2$$

Where:

V = wind speed, in m/s; to be taken as 63 m/s.

9.2.6 The wind force, F_w, acting on the structure is given by:

$$F_w = A p C_f \quad \text{kN}$$

Where:

A is the effective area of the structure concerned, i.e. the solid area projected on to a plane perpendicular to the wind direction, in m²

p is the wind pressure as defined in *Pt 3, Ch 9 9,2 Loading 9.2.5*

C_f is the force coefficient in the direction of the wind, as defined in *Table 9.9.2 Force coefficient C_f*

Table 9.9.2 Force coefficient C_f

Type	Description		Aerodynamic slenderness *l/b* or *l/D*					
			5	10	20	30	40	50
Individual members	Rolled sections, rectangles, hollow sections, flat plates, box sections with *b* or *d* less than 0,5 m		1,30	1,35	1,60	1,65	1,70	1,80
	Circular sections, where	$DV_s < 6\ m^2/s$	0,75	0,80	0,90	0,95	1,00	1,10
		$DV_s \geq 6\ m^2/s$	0,60	0,65	0,70	0,70	0,75	0,80
	Box sections with *b* or *d* greater than 0,5 m	*b/d*						
		≥2,00	1,55	1,75	1,95	2,10	2,20	
		1,00	1,40	1,55	1,75	1,85	1,90	
		0,50	1,00	1,20	1,30	1,35	1,40	
		0,25	0.80	0.90	0,90	1,00	1,00	
Single lattice frames	Flat sided sections		1,70					

	Circular sections, where $DV_s < 6\ m^2/s$ $DV_s \geq 6\ m^2/s$	1,20 0,80
Plated structure	Plated structures on solid base (air flow beneath structure prevented)	1,10
Symbols		
l = length of member D = diameter of circular section V_s = wind speed, in m/s b = breadth of box section, in metres d = depth of box section, in metres		

9.3 Support structure for machinery on deck

9.3.1 The deck plating and underdeck structure are to be reinforced under machinery. Acceptable stress levels are as follows:

- $\sigma \leq 0{,}75\sigma_{\mathrm{ref}}$
- $\tau \leq 0{,}47\sigma_{\mathrm{ref}}$
- $\sigma_e \leq 0{,}85\sigma_{\mathrm{ref}}$

Where
σ = normal stress, in N/mm^2
τ = shear stress, in N/mm^2
σ_{e} = equivalent stress, in N/mm^2
σ_{ref} = reference stress of the material, in N/mm^2
$= \dfrac{235}{k_{\mathrm{L}}}$
k_{L} = as defined in *Pt 3 Ship Structures (General)*, *Table 2.1.1 Values of k_L*

9.3.2 Insert plates are to be incorporated in the deck plating in way of machinery foundations where considered necessary to limit deflection and reduce stress concentrations. The thickness of the insert plates is to be as required by the designer's calculations but in no case is to be taken as less than 1,5 times the thickness of the adjacent attached plating.

9.3.3 Where fitted, all inserts are to have well radiused corners and be suitably edge prepared prior to welding. The connection between the insert plate and the adjacent deck plating is to be full penetration. All other welding in way of the insert plate is generally to be double continuous and full penetration in way of critical locations. Tapers are to be not less than three to one.

Part 3, Chapter 13
Ship Control Systems

■ *Section 2*
Rudders

2.12 Connections of rudder blade structure with solid parts

2.12.1 Solid parts in forged or cast steel, which house the rudder stock or pintle, are ~~normally~~ to be provided with protrusions, except as follows, *see Figure 13.2.4 Cross-section of the connection between rudder blade structure and rudder stock housing*. These protrusions are not required when the web plate thickness is less than:
(a) 10 mm for web plates welded to the solid part on which the lower pintle of semi-spade rudder is housed and for vertical web plates welded to the solid part of the rudder stock coupling of spade rudders.
(b) 20 mm for other web plates.

2.14 Cone couplings with key

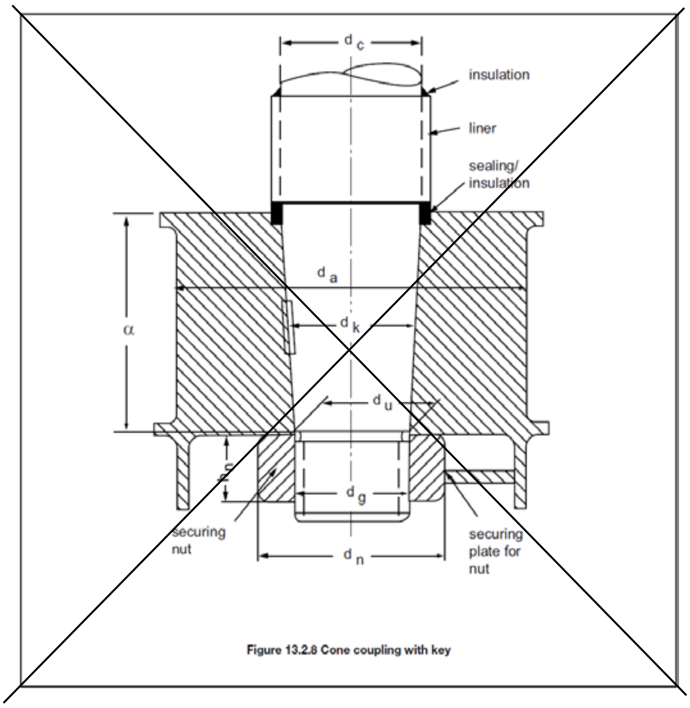


Figure 13.2.8 Cone coupling with key

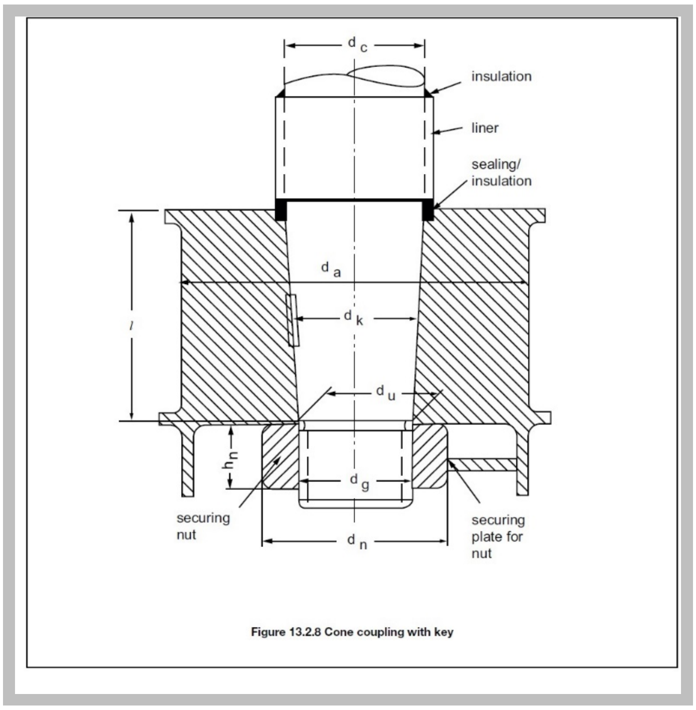


Figure 13.2.8 Cone coupling with key

2.15 Cone couplings with special arrangements for mounting and dismounting the couplings

2.15.4 The push up pressure, p_{req}, is not to be less than the greater of the two following values:

$$p_{\text{req1}} = \frac{2Q_\text{F}}{d_\text{m}{}^2 l \pi \mu_0} 10^3 \text{ N/mm}^2$$

$$p_{\text{req2}} = \frac{6M_\text{b}}{l^2 d_\text{m}} 10^3 \text{ N/mm}^2$$

where

Q_F = design yield moment of rudder stock, in Nm, as defined in *Pt 3, Ch 13, 2.14 Cone couplings with key 2.14.3*.

d_m = mean cone diameter in, mm = $\frac{(d_u+d_c)}{2}$.

l = cone length in, mm, *see Figure 13.2.8 Cone coupling with key*.

μ_0 = frictional coefficient, to be taken as 0,15.

M_b = bending moment in the cone coupling (e.g. in case of spade rudders), in Nm.

d_u = upper cone diameter, *see Figure 13.2.8 Cone coupling with key*.

d_c = lower cone diameter, *see Figure 13.2.8 Cone coupling with key*.

It has to be proved by the designer that the push-up pressure does not exceed the permissible surface pressure in the cone. The permissible surface pressure is to be determined by the following formula:

$$\cancel{p_{perm} = \frac{0.8\sigma_g(1-\alpha^2)}{\sqrt{3+\alpha^4}} \text{ N/mm}^2}$$

$$p_\text{perm} = \frac{0{,}95\sigma_\text{g}(1-\alpha^2)}{\sqrt{3+\alpha^4}} - p_\text{b} \text{ N/mm}^2$$

where

$$p_\text{b} = \frac{3{,}5M_\text{b}}{d_\text{m} l^2} 10^3$$

σ_g = minimum specified yield stress of the material of the gudgeon in N/mm^2.

$$\alpha = \frac{d_\text{m}}{d_\text{a}}$$

d_m = mean cone diameter in, mm~~, *see Figure 13.2.8 Cone coupling with key*~~.

d_a = outer diameter of the gudgeon to be not less than ~~1,5 d_m~~ 1,25d_c, in mm, *see Figure 13.2.8 Cone coupling with key.*

l = cone length in, mm, *see Figure 13.2.8 Cone coupling with key*.

M_b = bending moment in the cone coupling (e.g. in case of spade rudders), in Nm.

2.15.5 The push-up length Δl, is to comply with the following formula~~, but in no case is to be less than 2 mm~~:

$$\Delta l_1 \leq \Delta l \leq \Delta l_2$$

where

$$\cancel{\Delta l_1 = \frac{p_{req}}{E\frac{1-\alpha^2}{2}\theta_t} + \frac{0{,}8\,R_{tm}}{\theta_t}\,mm} \qquad \Delta l_1 = \frac{p_{\mathrm{req}} d_{\mathrm{m}}}{E\left(\frac{1-\alpha^2}{2}\right)\theta_{\mathrm{t}}} + \frac{0{,}8\,R_{\mathrm{tm}}}{\theta_{\mathrm{t}}}\ \mathrm{mm}$$

$$\cancel{\Delta l_2 = \frac{1{,}6\sigma_g d d_m}{E\theta_t\sqrt{3+\alpha^4}} + \frac{0{,}8\,R_{tm}}{\theta_t}\,mm} \qquad \Delta l_2 = \frac{p_{\mathrm{perm}} d_{\mathrm{m}}}{E\left(\frac{1-\alpha^2}{2}\right)\theta_{\mathrm{t}}} + \frac{0{,}8\,R_{\mathrm{tm}}}{\theta_{\mathrm{t}}}\ \mathrm{mm}$$

where

~~P~~p_{req}, p_{perm}, α, d_m are defined in *Pt 3, Ch 13, 2.15 Cone couplings with special arrangements for mounting and dismounting the couplings 2.15.4*

R_{tm} = mean roughness in, mm, taken equal to 0,01

E = Young's modulus of the material, in N/mm^2

θ_t = taper on diameter, *see ~~Pt 3, Ch 13, 2.15 Cone couplings with special arrangements for mounting and dismounting the couplings 2.15.1~~ Pt 3, Ch 13, 2.14 Cone couplings with key*

2.16 Pintles

2.16.5 The required push-up pressure for pintles ~~bearings~~ is to be determined by the following formula:

$$\cancel{p_{req} = 0{,}4\frac{B d_p}{{d_m}^2 l}\ N/mm^2} \qquad p_{\mathrm{req}} = 0{,}4\frac{B_1 d_{\mathrm{p}}}{{d_{\mathrm{m}}}^2 l}\ \mathrm{N/mm^2}$$

where

d_m~~,~~ and l are defined in *Pt 3 Ch 13, 2.15 Cone couplings with special arrangements for mounting and dismounting the couplings 2.15.4*

B_1 = supporting force in the pintle ~~bearing~~, in N

d_p = actual pintle diameter, in mm.

The push-up length is to be calculated in accordance with *Pt 3, Ch 13, 2.15 Cone couplings with special arrangements for mounting and dismounting the couplings 2.15.5*, using the required push-up pressure and properties for the pintle ~~bearing~~.

Part 3, Chapter 14
Cargo Securing Arrangements

■ *Section 1* General

1.2 Classification notations and descriptive notes

1.2.5 The container securing arrangements of a container ship may take into account specific voyage routes and seasons, provided the ship has been assigned the special features notation **BoxMax** with one of the following supplementary letter sequences: **V** or **V,W** or **V,W,L** or **M**. The features offered by these supplementary letter sequences are defined in *Table 14.1.1 BoxMax notation features*.

1.2.6 The onboard lashing program is to be capable of performing calculations specific to defined sea areas and seasons, and the weather~~-~~ dependent factors for these areas and seasons have been supplied by LR.

- If the weather~~-~~ dependent factors have been supplied by LR for specific sea areas, the ship will be eligible to be assigned the special features notation **BoxMax(V)**.
- If the factors have been supplied by LR for specific sea areas in combination with seasons, the ship will be eligible to be assigned the special features notation **BoxMax(V,W)**.

- If the factors have been supplied by LR for limited voyages, the ship will be eligible to be assigned the special features notation **BoxMax(V,W,L)**.
- If the factors have been supplied by LR for ship motions and environmental conditions, the ship will be eligible to be assigned the special features notation **BoxMax(M)**.

~~1.2.9 The Operational Guidance Document, see *Pt 3, Ch 14, 1.6 Symbols and definitions 1.6.1*, is only considered applicable if the vessel is assigned and is operated with the **BoxMax** notation.~~

Table 14.1.1 BoxMax notation features *(Part only shown)*

Notation	Additional feature description
BoxMax(V,W,L)	**L**: Limited duration voyages The **BoxMax(V,W,L)** notation potentially allows increased flexibility for the carriage of containers on- board the ship for limited duration voyages. When applying the **L** feature, limited duration voyage factors are applicable for voyages of less than 48 hours. They are suitable for short coastal voyages, for example between ports such as Hamburg and Rotterdam or between Hong Kong and Xiamen (China). Typically it will allow enhanced flexibility for the carriage of containers and may allow reduced lashing requirements between local ports. The process of application of the **BoxMax(V,W,L)** limited duration voyage feature is given in *Pt 3, Ch 14, 1.3 Application of the BoxMax(V,W,L) notation*. The weather dependent factors applicable to limited duration voyages based on wave heights predicted by weather forecasts will be supplied by LR.
BoxMax(M)	**M**: Ship motion monitoring The **BoxMax(M)** notation allows maximum flexibility in the way containers are carried for any voyage. The degree of lashing can be fully appropriate to operation, *see* Note 3. The Master will be required to manage the motion of the ship during the voyage by good seamanship and by weather routing, and not exceed the declared ship motions. The maximum motion of the ship during the voyage is to be recorded and compared to the declared ship motion. The process of application of the **BoxMax(M)** ship motion monitoring feature is given in *Pt 3, Ch 14, 1.4 Application of the BoxMax(M) notation*.
Note 1: The weather dependent factors are described in *Pt 3, Ch 14, 1.6 Symbols and definitions 1.6.1*. **Note** 2: LR will supply weather dependent factors applicable to the list of sea areas requested by the owner. The requested sea areas must cover the whole of the voyage route to be used. If the vessel sails outside of the requested sea areas then all the weather dependent factors should be set to 1,0. **Note** 3: LR will supply weather dependent factors in the form of a look up table specific to the ship; the voyage factors shall be selected based on the maximum ship motion being declared.	

1.2.8 A ship designed to carry containers that is provided with safe access and securing arrangements in accordance with the ~~Provisional Rules and Regulations for Ergonomic Container Lashing~~ *Rules and Regulations for Ergonomic Container Lashing, December 2014* will be eligible to be assigned the special features notation **ECL** (Ergonomic Container Lashing), with supplementary descriptor.

1.3 Application of the BoxMax(V,W,L) notation

1.3.2 For the limited duration voyage feature to be applicable the following process must be in place:

a) The ship must subscribe to an ocean weather forecast service provided by a recognised and reputable met ocean weather forecasting organisation. The forecast is to include wind speed and wave heights for a minimum period of 5 days and preferably 10 days. The responsibility for selection of the weather forecasting organisation lies with the Master.

b) ~~The ship must have the Operational Guidance document on board, as described in *Pt 3, Ch 14, 1.6 Symbols and definitions 1.6.1*.~~ The limited voyage feature shall not hazard safe navigation and adverse weather conditions should be avoided as far as possible.

~~c) The Master should take care to ensure that the ship avoids speeds and headings where large rolling motions are indicated in the Operational Guidance document.~~

1.3.8 Example of application of **BoxMax(V,W,L)**:

(*Part only shown*)
Scenario 1

Forecast day 17 July @ 12:00

Forecast time	-	-	-	12:00		
Forecast wave height	-	-	-	3,8 m	4,1 m	4,0 m
Action	-	-	-	Max forecast wave height increased to 4,1 m. 4,1 m is less than planning wave height of 5,0 m Voyage can be undertaken. Monitor latest forecast and actual sea state ~~and consult Operational Guidance Document~~		

Forecast day 18 July @ 12:00

Forecast time	-	-	-	-	12:00	
Forecast wave height	-	-	-	-	4,2 m	4,0 m
Action	-	-	-	-	Monitor latest forecast and actual sea state ~~and consult Operational Guidance Document~~	

(*Part only shown*)
Scenario 2

Forecast day 18 July @ 12:00

Forecast time	-	-	-	-	12:00	
Forecast wave height	-	-	-	-	5,5 m	5,4 m
Action	-	-	-	-	Monitor latest forecast and actual sea state ~~and consult Operational Guidance Document~~	

1.4 Application of the BoxMax(M) notation

1.4.1 The **BoxMax(M)** notation requires the following process to be applied by the ship's Master.

1.4.2 For the ship motion monitoring notation to be applicable the following process must be in place:

a) At the start of a voyage, the Master shall declare the maximum expected ship motions and environmental conditions and assign weather dependent factors accordingly. The responsibility for selection of appropriate ship motions and environmental conditions lies with the Master.

b) The ship motion monitoring feature shall not hazard safe navigation and adverse weather conditions should be avoided as far as possible.

1.4.3 The supplied weather dependent factors applicable to ship motion notation are based on the declared ship motion and environmental conditions.

1.4.4 The maximum ship motion, environmental conditions and weather dependent factors planned for the voyage should be recorded in the cargo plan information and the onboard lashing computer for the voyage. The ship specific weather dependent coefficients for a range of ship motion and environmental conditions will be provided by LR as part of the **BoxMax(M)** notation.

1.4.5 LR can provide ship specific guidance with regard to voyage ship motion predictions and environmental loading.

Sub-Sections 1.4 to 1.6 have been renumbered 1.5 to 1.7.

~~1.4~~ 1.5 Plans and information required

(*Part only shown*)

~~1.4.3~~ 1.5.3 The Cargo Securing Manual is to include the following information:

~~a) Representative lashing calculations based on two design *GM* values as follows:~~

~~i) a lower design *GM* value of 2,5 per cent of the breadth *B*.~~

~~ii) an upper design *GM* value of 7,5 per cent of *B* for ships with a breadth less than 52 m and 10 per cent of *B* for ships where *B* ≥ 52 m.~~

~~b) In addition to these two design GM values, actual GM values of the ship in the container loaded condition from the approved Trim and Stability Booklet or Loading Manual are to be included when the actual design GM values are outside the above range and the vessel does not have an approved onboard lashing program.~~

a) For vessels with an approved onboard lashing program, representative lashing calculations based on one design *GM* value within the following range:
   - i) A lower design *GM* value of 2,5 per cent of the breadth *B*.
   - ii) An upper design *GM* value of 7,5 per cent of *B* for ships with a breadth less than 52 m and 10 per cent of *B* for ships where *B* ≥ 52 m.

b) For vessels without an approved onboard lashing program, representative lashing calculations based on design *GM* values as follows:
   - i) A lower design *GM* value of 2,5 per cent of the breadth *B*.
   - ii) An upper design *GM* value of 7,5 per cent of *B* for ships with a breadth less than 52 m and 10 per cent of *B* for ships where *B* ≥ 52 m.
   - iii) Actual GM values of the ship in the container loaded condition from the approved Trim and Stability Booklet or Loading Manual when the actual design GM values are outside the range specified in i) and ii).

c) For vessels with notation **BoxMax(V)**, **BoxMax(V,W)**, ~~or~~ **BoxMax(V,W,L)** or **BoxMax(M)** representative calculations based on applicable weather reduction factors are to be included in the Cargo Securing Manual.

~~d) Lashing calculations in the Cargo Securing Manual are to be based on the maximum service speed *V* (*see Pt 3, Ch 1, 6.1 Principle particulars 6.1.10*). For vessels for which the voyage speed V_d may be less than the maximum service speed *V*, representative example calculations are to be included a lower value of voyage speed V_d.~~

~~1.6~~ 1.7 Symbols and definitions

(*Part only shown*)

~~1.6.1~~ 1.7.1 The following definitions are applicable to this Chapter, except where otherwise stated:

For ships with breadth, *B*, between 54 m and 58 m, the minimum unrestricted roll angle is to be determined by linear interpolation.

~~f_v = 0,175Vd -2,2 but is not to be taken less than 1,0~~

f_v is to be taken as 1,0

$f_{gm} = \frac{7,5\,GM}{B} + 0,6$ but is not to be taken less than 1,0

~~V_d is the voyage speed, in knots. V_d is the maximum sailing speed for the intended voyage for which the container stowage arrangements are being designed.~~

Note The calculations assume that the Master takes action to avoid synchronous rolling and parametric rolling. LR can provide ship specific guidance with regard to synchronous rolling and parametric rolling. ~~If the roll angle φ_f for container securing arrangements is less than 22 degrees for a *GM* value of 5 per cent of the breadth, *B*, then the following information is to be provided to the Master as an Operational Guidance Document and is also to be included in the Trim and Stability Booklet or the Loading Manual:~~

~~Presentation of the predicted roll angles taking into account the following parameters:~~

- ~~GM value,~~
- ~~Ship's speeds up to the maximum speed,~~
- ~~Ship to wave heading,~~
- ~~Wave height.~~

~~This information is to be provided for the normal operating design draught. If it is expected that the ship will operate with a wide range of draughts, then the predicted roll angles should be provided for additional draughts. The roll angle prediction should be determined on the following basis: probable maximum roll angle in 3 hours based on a 1-year return period for the wave heights, calculated using short-term statistical techniques, a cosine^2 heading probability and roll damping values appropriate for the predicted roll angles.~~

~~The roll angle data should include the effects of synchronous rolling to the waves and also parametric rolling. Prediction of parametric roll angles is very difficult and it is sufficient to show the headings and speeds where parametric rolling is likely for each *GM* value. If such information is not provided, then the design roll angle φ_f for container securing arrangements is to be taken as not less than φ_m.~~

■ *Section 5*

Container securing arrangements for stowage on exposed decks without cell guides

5.4 Containers in more than two tiers

~~5.4.5 External para-lash arrangements are not recommended. Proposals to use such an arrangement will be specially considered.~~

Paragraphs 5.4.6 to 5.4.13 have been renumbered 5.4.5 to 5.4.12.

■ *Section 7*

Container securing arrangements for stowage using cell guides

7.3 Carriage of 20 ft containers in 40 ft cell guides in holds

(*Part only shown*)

7.3.3 Where it is desired to stow 20 ft containers without external support at the mid-bay location with or without 40 ft overstow, so-called 'mixed stowage' arrangements meeting the following requirements are applicable:

e) The force in the corner post in the lowest container is not to exceed the permissible compression value given in *Table 14.9.6 Allowable forces in containers in stacks with the same base size*. The force is to be determined by:

$$V = -\frac{a_z\left(w_{40s} + W_{20s-1}\right)}{4}$$

where:

V is the compressive force in the corner post

W_{40s} is the total weight of the 40 ft containers, in tonnes

W_{20S-1} is the total weight of the 20 ft containers excluding the weight of the lowest container, in tonnes

a_Z is the maximum vertical acceleration of all containers in the stack, see *Pt 3, Ch 14, 8.2 Ship motion, wind and green sea forces acting on containers 8.2.5*

7.3.4 Alternative proposals for stowage arrangements will be individually considered ~~other than the above will be individually considered~~ and are to be accompanied by supporting calculations.

■ *Section 9*

Strength of container securing arrangements

9.3 Analysis of the container stack

9.3.11 Where lashing devices are attached to a lashing bridge, the lashing bridge transverse stiffness is to be taken into account and may be modelled as an additional rod element. For lashing bridge designs with multiple lashing platforms, a lashing bridge rod element is required for each platform. All the lashing bridge rod elements are to be connected in series. The bottom of the lashing bridge can be assumed to be rigidly fixed.

~~The transverse spring stiffness of the lashing bridge is to be determined/verified using the ShipRight SDA Procedure for the Assessment of Container Ship Lashing Bridge Structures. Where the lashing bridge design is not available, each lashing platform may be modelled with a rod with a transverse spring stiffness (~~$\cancel{K_{byi}}$~~) calculated from the following:~~

A default Rule stiffness for each platform of the lashing bridge is to be modelled with a rod with a transverse spring stiffness (K_{lbyi}) calculated from the following:

$$K_{\text{lbyi}} = \frac{C_{\text{lb}}}{H_{\text{lbi}}}\ \text{kN/mm}$$

~~W~~where~~,~~

H_{lbi} is the height of lashing bridge tier i, taken in m, see *Figure 14.9.1 Lashing bridge transverse spring stiffness*

C_{lb} is the lashing bridge stiffness coefficient, taken as 50 for single elevated lashing bridge tiers at the outer stack, *see Figure 14.9.1 Lashing bridge transverse stiffness*, and 70 otherwise.

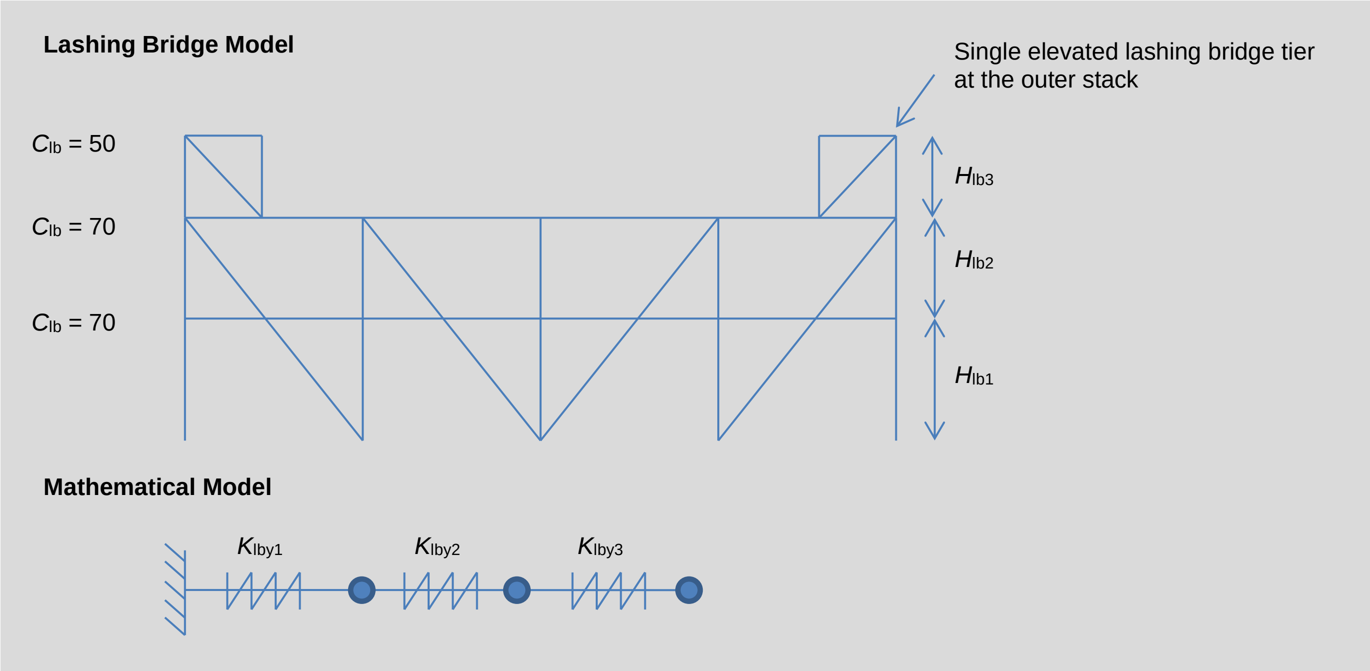
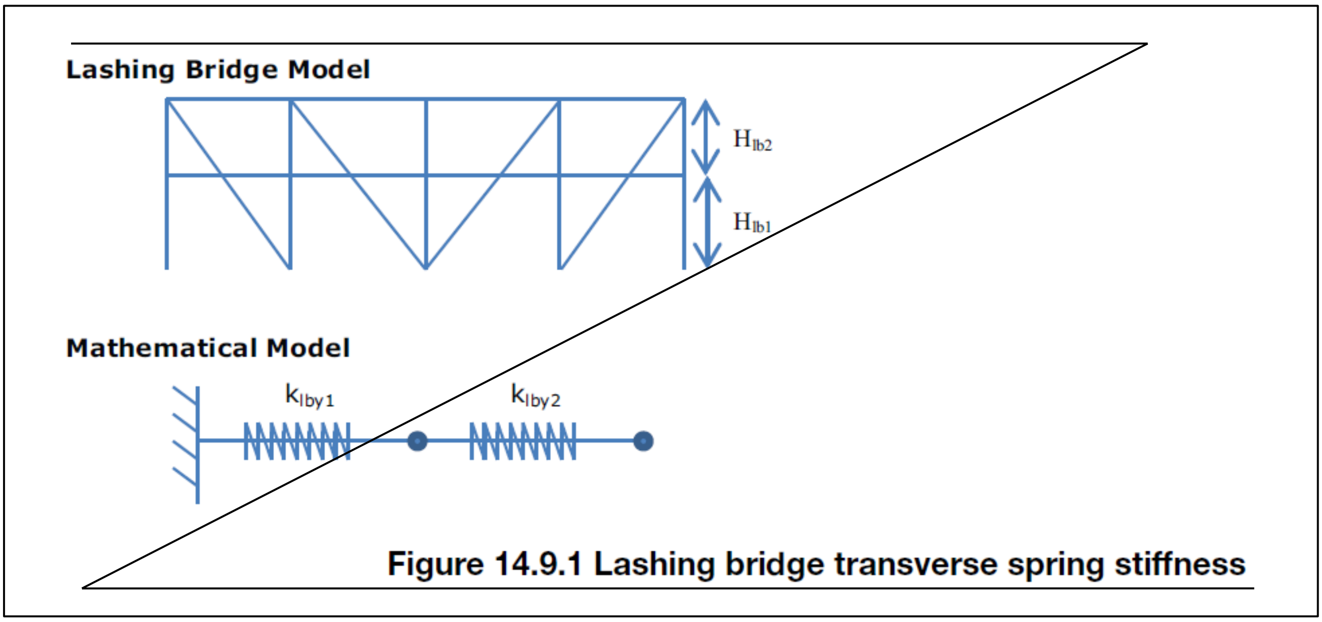


Figure 14.9.1 Lashing bridge transverse spring stiffness



~~**Figure 14.9.1 Lashing bridge transverse spring stiffness**~~

9.3.12 For lashing bridge designs having a higher transverse stiffness than the default stiffness value of $70/H_{\text{lbi}}$, in kN/mm, the stack analysis can be based on the actual stiffness value determined in accordance with the *ShipRight ADP Procedure for the Assessment of Container Ship Lashing Bridge Structures*.

9.3.13 Alternative proposals for the transverse stiffness of the lashing bridge will be individually considered.

Paragraphs 9.3.12 to 9.3.15 have been renumbered to 9.3.14 to 9.3.17.

Table 14.9.6 Allowable forces in containers in stacks with the same base size

	20 ft	40 ft	45 ft
	in kN		
Horizontal force from a container casting acting parallel to the side face	150	150	150
Horizontal force from lashing on container casting acting parallel to the end face, see Note 1	225	225	225
Vertical force from lashing on lower container casting acting parallel to the end or side face, see Note 1	250	250	250
Resultant force from ~~para~~ lashing on upper container casting acting parallel to the end or side face	188	188	188
Racking force on container end	150	150	150
Racking force on container side	150	150	150
Vertical forces at each top corner casting, tension	250	250	250
Vertical forces at each bottom corner casting, tension	250	250	250
Vertical forces at each top corner casting and in each corner post, compression	848 *see* Note 4	848 *see* Note 4	942
Vertical forces at each bottom corner casting, compression	848+(1,8R-g/4) *see* Note 3	848+(1,8R-g/4) *see* Note 3	942+(1,8R-g/4) *see* Note 3
Transverse forces acting at the level of and parallel to the top face, tension or compression, see Note 2	340	340	340
Transverse forces acting at the level of and parallel to the bottom face, tension or compression, see Note 2	500	500	500

Note 1. In no case is the resultant of the horizontal and the vertical forces to exceed the limiting values derived from *Figure 14.9.2 Allowable forces for 20 ft or 40 ft containers constructed to ISO 1496-1:1990 including Amendment Nos. 1, 2 and 3*. The horizontal and vertical forces are the maximum components of a diagonal force and are not to be used as the maximum load if horizontal or vertical lashings are employed.
Note 2. Where a buttress supports the stack at an intermediate level, the total transverse force in the containers at the level is not to exceed the sum of the appropriate top and bottom forces.
Note 3. The vertical compression force on the lower corner casting on the closed end of the lowest container may exceed 848 + (1,8Rg/4) kN or 942 + (1,8-Rg/4) as applicable, provided the following conditions are complied with:

- (a) The vertical compression force acting on the lowest container from the container above does not exceed 848 kN.
- (b) The horizontal racking force acting on the lowest container from the container above does not exceed 150 kN.
- (c) The local ship side or hatch cover container foundation is designed and approved for the increased design compression force.
- (d) The loose bottom container securing fittings should have a contact area fulfilling the requirements of *Pt 3, Ch 14, 3.2 Materials and design 3.2.5*.

Note 4. Containers that are certified to comply with ISO 1496-1:1990 including Amendment 4 may have the top corner casting and post compression increased to 942 kN.

Part 4, Chapter 1
General Cargo Ships

■ *Section 8*
Double bottom structure

8.2 General

8.2.3 Small wells constructed in the double bottom, in connection with ~~the~~ drainage arrangements ~~of holds~~, are not to extend in depth more than necessary. ~~A well extending to the outer bottom may, however, be permitted at the after end of the shaft tunnel of the ship.~~ ~~Other well arrangements (e.g. for lubricating oil under main engines) may be considered provided they give protection equivalent to that afforded by the double bottom.~~ In no case shall the vertical distance from the bottom of such a well to a plane coinciding with the keel line be less than 500 mm or *B*/40 whichever is greater for passenger ships and cargo ships other than tankers unless compliance for that part of the ship with paragraph 8 of SOLAS Chapter II-1 *Regulation 9 – Double bottoms in passenger ships and cargo ships other tankers* is demonstrated. Keel line is defined in SOLAS Chapter II-1, Part A, *Regulation 2 – Definitions* and *B* is defined in *Pt 4, Ch 1, 1 General 1.5.1*.

8.2.4 Other well arrangements (e.g. for lubricating oil under main engines) can be considered provided they give protection equivalent to that afforded by the double bottom. For a cargo ship of 80 m in length and upwards or for a passenger ship, proof of equivalent protection is to be shown by demonstrating that the ship is capable of withstanding bottom damages as specified in paragraph 8 of SOLAS Chapter II-1 *Regulation 9 – Double bottoms in passenger ships and cargo ships other tankers*. Alternatively, wells for lubricating oil below main engines can protrude into the double bottom below the boundary line defined by the distance *B*/20 provided that the vertical distance between the well bottom and a plane coinciding with the keel line is not less than *B*/40 or 500 mm, whichever is greater. For cargo ships of less than 80 m in length, the arrangements shall provide a level of safety satisfactory to the Flag Administration.

Existing paragraphs 8.2.4 to 8.2.9 have been renumbered as 8.2.5 to 8.2.10.

Part 4, Chapter 2
Ferries, Roll On-Roll Off Ships and Passenger Ships

■ *Section 1*
General

1.1 Application

(Part only shown)
1.1.1 This Chapter applies to seagoing passenger ships and ferries, including those with roll on-roll off capability, as well as passenger yachts, sailing passenger ships, roll on-roll off cargo ships and vehicle carriers defined as follows:

(f) A **passenger yacht** is defined as a yacht that is specially designed and constructed in accordance with National Administration requirements for passenger yachts ~~with due regard to the applicability of the conventions as given in *Pt 1, Ch 2, 1.1 General 1.1.9*, as determined in accordance with the *PYC – A Code of Practice for Yachts Carrying 13 to 36 Passengers (Passenger Yacht Code) as amended* or an alternative administration code deemed acceptable by LR~~.

Part 4, Chapter 4
Offshore Support Vessels

■ *Section 1*
General

1.1 Application

(Part only shown)
Table 4.1.1 Type notations applicable to offshore support vessels

Class Notation	Requirements
~~**Offshore well stimulation**~~	~~Provisional Rules for the Construction and Classification of Offshore Well Stimulation Ships~~

■ *Section 2*
Materials

2.3 Requirements for the use of thick steel plates

2.3.6 A number of measures are given in *Table 8.2.1 Preventative measures to be used in design and construction for thick steel plates* which are considered to be acceptable means of addressing the cases given in *Pt 4, Ch 8, 2.3 Requirements for the use of thick steel plates 2.3.4.* A range of thicknesses is shown for the different strength grades of steel. Where the maximum as-built thickness of the hatch coaming top plate and side plate falls within this range, measures are to be selected as shown in the Table. If the as-built thickness of the hatch coaming top plate and side plate is below the values contained in the Table, then additional measures are not necessary regardless of the thickness and yield strength of the upper deck plating. The application of these measures is described in *Pt 4, Ch 8, 2.3 Requirements for the use of thick steel plates 2.3.7* to *Pt 4, Ch 8, 2.3 Requirements for the use of thick steel plates 2.3.11.*

Existing paragraph 2.3.6 has been renumbered 2.3.7.

Existing Table 8.2.1 has been replaced with the following:

Table 8.2.1 Preventative measures to be used in design and construction for thick steel plates

Nominal yield strength (N/mm^2)	Thickness of hatch coaming plating, *see* Note 3 (mm)	Measure, *see* Note 1				
		1	2	3	4 *see* Note 2	5 *see* Note 2
355	$50 < t \leq 85$	Not required	Not required	Not required	Not required	Not required
	$85 < t \leq 100$	Required	Not required	Not required	Not required	Not required
390	$50 < t \leq 85$	Required	Not required	Not required	Not required	Not required
	$85 < t \leq 100$	Required	Required	Required	Required	Required
460	$50 < t \leq 85$	Required	Required	Required	Required	Required
	$85 < t \leq 100$	Required	Required	Required	Required	Required

Key to measures	
Measure 1:	NDE during construction on all upper flange longitudinal members, *see Pt 4, Ch 8, 2.3 Requirements for the use of thick steel plates 2.3.7*
Measure 2:	Block shift, crack arrest insert plates, crack arrest holes and enhanced NDE, *see Pt 4, Ch 8, 2.3 Requirements for the use of thick steel plates 2.3.8*
Measure 3:	Crack arrest steel for the upper deck, *see Pt 4, Ch 8, 2.3 Requirements for the use of thick steel plates 2.3.9*
Measure 4:	Periodic in-service NDE, *see Pt 4, Ch 8, 2.3 Requirements for the use of thick steel plates 2.3.10*
Measure 5:	Tough welds, *see Pt 4, Ch 8, 2.3 Requirements for the use of thick steel plates 2.3.11*
Note 1	Measures are to be applied where 'Required' is shown.
Note 2	Measures 4 and 5 are only required where enhanced NDE during construction has been applied as part of Measure 2.
Note 3	Hatch coaming plating includes side plating and top plating.

~~2.3.7~~ 2.3.8 Where Measure 2 is required in *Table 8.2.1 Preventative measures to be used in design and construction for thick steel plates*, the ~~The~~ following are considered to be acceptable examples of brittle crack arrest design for the case given in *Pt 4, Ch 8, 2.3 Requirements for use of thick steel plates 2.3.4(a)*:

a) Where the block-to-block butt welds of the hatch side coaming plate and those of the upper deck are staggered, this offset is to be greater than or equal to 300 mm. This offset distance is defined in *Figure 8.2.2 Minimum offset between block-to-block butt welds of the hatch side coaming and those of the upper deck staggered*. Brittle crack arrest steel, as defined in *Pt 4, Ch 8, 2.3 Requirements for use of thick steel plates ~~2.3.9~~2.3.12*, is to be provided for the hatch side coaming plate.

b) Where crack arrest holes are provided in way of the block-to-block butt welds at the region where the hatch side coaming weld meets the deck weld, *see Figure 8.2.3 Crack arrest hole in way of the block-to-block butt weld at the region where hatch side coaming weld meets the deck weld*, the corners of the crack arrest holes located where the hatch side coaming joints meet the deck weld are to be specially assessed for fatigue strength. The fatigue strength is also to be assessed at the location where the block-to-block butt weld intersects the crack arrest hole. Brittle crack arrest steel, as defined in *Pt 4, Ch 8, 2.3 Requirements for use of thick steel plates ~~2.3.9~~2.3.12,* is to be provided for the hatch side coaming plate.

c) Where higher crack arrest steel insert plates such as SUF (Surface Layer with Ultras-Fine grain) steel or equivalent, or weld metal inserts with high crack arrest toughness properties are provided in way of the block-to-block butt welds at the region where hatch

side coaming weld meets the deck weld. Brittle crack arrest steel, as defined in *Pt 4, Ch 8, 2.3 Requirements for use of thick steel plates ~~2.3.9~~2.3.12*, is to be provided for the hatch side coaming plate.

d) As an alternative to the provision of crack arrest steel for the hatch coaming side plate stipulated in *Pt 4, Ch 8, 2.3 Requirements for the use thick steel plates 2.3.8* (a), *Pt 4, Ch 8, 2.3 Requirements for the use thick steel plates 2.3.8* (b) and *Pt 4, Ch 8, 2.3 Requirements for the use thick steel plates 2.3.8* (c), enhanced non-destructive examination can be carried out in association with stricter acceptance criteria. The acceptance criteria are to be determined through the means of an engineering critical assessment (ECA) to be carried out in accordance with Chapter 2 of the *ShipRight Procedure for the Use of Enhanced NDE in Container Ships,* and the enhanced NDE is to be carried out in accordance with Chapter 3 of the *ShipRight Procedure for the Use of Enhanced NDE in Container Ships*. Other mechanical means of crack arrest such as block shift, crack arrest insert plates and crack arrest holes are still to be fitted. This approach also requires a programme of non-destructive testing during the lifetime of the ship, *see Pt 4, Ch 8, 2.3 Requirements for the use thick steel plates 2.3.10*. The weld toughness of the block to block butt welds of the hatch coaming side plate, hatch coaming top plate and upper deck is to be as required by *Pt 4, Ch 8, 2.3 Requirements for the use thick steel plates 2.3.8* and EGW welding is not permitted.

~~2.3.8~~ 2.3.9 Where Measure 3 is required in *Table 8.2.1 Preventative measures to be used in design and construction for thick steel plates* for ~~For~~ the cases given in *Pt 4, Ch 8, 2.3 Requirements for use of thick steel plates 2.3.4.(b)* and *Pt 4, Ch 8, 2.3 Requirements for use of thick steel plates 2.3.4.(c)*, the use of brittle crack arrest steel, as defined in *Pt 4, Ch 8, 2.3 Requirements for use of thick steel plates ~~2.3.9~~2.3.12*, for the upper deck along the cargo hold region is considered to be an acceptable means to arrest a brittle crack initiating from the coaming side and top plate and propagating into the structure below.

Existing paragraphs 2.3.9 and 2.3.10 have been renumbered 2.3.12 and 2.3.13.

2.3.10 Where Measure 4 is required in *Table 8.2.1 Preventative measures to be used in design and construction for thick steel plates,* periodic NDE during service is to be carried out in accordance with Chapter 3 of the *ShipRight Procedure for the Use of Enhanced NDE in Container Ships*.

2.3.11 Where Measure 5 is required in *Table 8.2.1 Preventative measures to be used in design and construction for thick steel plates,* the block to block butt welds of the hatch coaming side plate, hatch coaming top plate and upper deck are to have a minimum crack tip opening displacement (CTOD) value of 0,18 mm. The CTOD tests to confirm the CTOD value are to be carried out to the satisfaction of LR.

~~2.3.11 As an alternative to *Pt 4, Ch 8, 2.3 Requirements for use of thick steel plates 2.3.7*, consideration may be given to the use of crack arrest steel in all the structural parts of the hatch coaming top, hatch coamings, upper deck and first strake below the upper deck.~~

~~2.3.12 As an alternative to crack arrest design, design based on crack initiation may be considered. Design based on this approach aims to prevent any defect from propagating into a brittle fracture by ensuring that no defect exists above a calculated size in the weld either during construction or subsequently in service. This size is determined by way of an Engineering Critical Assessment (ECA) which must be carried out and submitted to LR prior to construction. The ECA will determine the maximum acceptable defect size from both fatigue crack growth and fracture mechanics calculations. The detectability of such a defect in the structure will also need to be proven to LR. This can only be achieved through assessment of the non-destructive examination techniques and procedures to be applied. It is anticipated that, for this approach to be successful, the application of advanced NDT, such as the Time of Flight Diffraction (TOFD) technique or the Phased Array Ultrasonic Testing (PAUT) technique, will be necessary. The approach will also need to include a programme of non-destructive testing during the lifetime of the ship in order to ensure that growth of a defect does not exceed the limits of the ECA.~~

~~2.3.13 *Table 8.2.1 Preventative measures to be used in design and construction for thick steel plates* summarises a selection of measures aimed at mitigating the risk of uncontrolled brittle fracture in way of deck and hatch coaming structure. A range of thicknesses is shown for the different strength grades of steel; where the maximum as-built thickness of the hatch coaming top plate and side plate falls within this range, measures are to be selected as shown in the Table. If the as-built thickness of the hatch coaming top plate and side plate is below the values contained in the Table, then additional measures are not necessary regardless of the thickness and yield strength of the upper deck plating~~

■ *Section 13*
Container stowage systems

13.3 Ergonomic container lashing

13.3.1 A ship designed to carry containers that is provided with safe access and securing arrangements in accordance with the ~~*Provisional*~~ *Rules for Ergonomic Container Lashing, December 2014* will be eligible to be assigned the special features notation **ECL** (Ergonomic Container Lashing), with supplementary descriptor.

Published by Lloyd's Register Group Limited
Registered office (Reg. no. 08126909)
71 Fenchurch Street, London, EC3M 4BS
United Kingdom